

Claims

1.-35. (Canceled)

36. (Currently Amended) A ~~multi-resolution~~ method for decoding a bitstream for a sequence of video frames, the method comprising:

receiving and processing first information ~~a multi-resolution signal in a sequence header for a video~~ the sequence of plural encoded frames, wherein the first information ~~multi-resolution signal~~ indicates whether ~~the plural frames in the video sequence are encoded at more than one~~ multiple spatial resolution coding is enabled for the sequence; and

if the ~~plural frames are encoded at more than one~~ first information indicates that multiple spatial resolution coding is enabled for the sequence, then for each of plural frames in the sequence,

receiving and processing second information at frame level in the bitstream, the second information indicating one or more spatial resolution scaling factors for the frame;

and

outputting a result of the processing.

~~—decoding a first encoded frame of the plural encoded frames at a first spatial resolution, and~~

~~—decoding a second encoded frame of the plural encoded frames at a second spatial resolution.~~

37.-38. (Canceled)

39. (Currently Amended) The method of claim 36 wherein the one or more second spatial resolution scaling factors are ~~is~~ determined adaptively based at least in part on bitrate criteria.

40. (Currently Amended) The method of claim 36 wherein the one or more second spatial resolution scaling factors are ~~is~~ determined adaptively based at least in part on high-frequency content criteria.

41. (Currently Amended) The method of claim 36 wherein the one or more second spatial resolution scaling factors are ~~is~~-determined adaptively based at least in part on quantization step size criteria.

42.-61. (Canceled)

62. (New) The method of claim 36 wherein the plural frames comprise at least one I-frame.

63. (New) The method of claim 36 wherein the plural frames comprise at least one I-frame and at least one P-frame.

64. (New) The method of claim 63 wherein for the at least one P-frame the one or more spatial resolution scaling factors are constrained to be identical to one or more spatial resolution scaling factors for a reference I-frame for the at least one P-frame.

65. (New) The method of claim 36 wherein the second information is a fixed-length code.

66. (New) The method of claim 65 wherein the fixed-length code is a 2-bit code that represents 4 possible states of the one or more spatial resolution scaling factors.

67. (New) The method of claim 36 wherein the second information is a variable-length code.

68. (New) The method of claim 36 wherein the first information is signaled in a sequence header.

69. (New) The method of claim 68 wherein the first information is a 1-bit code in the sequence header.

70. (New) The method of claim 36 further comprising:
receiving and processing third information in the bitstream, the third information
indicating a selected re-sampling filter.

71. (New) The method of claim 36 wherein the one or more spatial resolution scaling
factors comprise a vertical spatial resolution scaling factor and a horizontal spatial resolution
scaling factor.

72. (New) The method of claim 71 wherein the vertical spatial resolution scaling factor
differs from the horizontal spatial resolution scaling factor.

73. (New) The method of claim 71 wherein the vertical spatial resolution scaling factor
is selected from a set of vertical spatial resolutions comprising full resolution and half resolution.

74. (New) The method of claim 71 wherein the horizontal spatial resolution scaling
factor is selected from a set of horizontal spatial resolutions comprising full resolution and half
resolution.

75. (New) The method of claim 36 further comprising:
if the first information indicates that multiple spatial resolution coding is enabled for the
sequence, decoding the sequence of video frames with multiple spatial resolution decoding
according to the spatial resolution scaling factors indicated by the second information;
otherwise, decoding the sequence of video frames without multiple spatial resolution
decoding; and
displaying the sequence of video frames.

76. (New) The method of claim 75 wherein the decoding with multiple spatial resolution
decoding comprises:
decoding a current frame of the plural frames encoded at a reduced spatial resolution; and

after decoding the current frame, up-sampling the current frame, wherein the up-sampling yields a full-resolution decoded frame.

77. (New) The method of claim 76 wherein the up-sampling comprises applying a 10-tap filter to the decoded current frame.

78. (New) The method of claim 76 wherein the displayed current frame at the reduced spatial resolution comprises reduced blocking artifacts.

79. (New) A method of encoding a bitstream for a sequence of video frames, the bitstream having plural levels, the method comprising:

outputting first information for the sequence, the first information indicating whether multiple spatial resolution coding is enabled for the sequence; and

if the first information indicates that multiple spatial resolution coding is enabled for the sequence, for each of plural frames in the sequence:

outputting second information at frame level in the bitstream, the second information indicating one or more spatial resolution scaling factors for the frame.

80. (New) The method of claim 79 wherein the plural frames comprise at least one I-frame.

81. (New) The method of claim 79 wherein the plural frames comprise at least one I-frame and at least one P-frame.

82. (New) The method of claim 81 wherein for the at least one P-frame the one or more spatial resolution scaling factors are constrained to be identical to one or more spatial resolution scaling factors for a reference I-frame for the at least one P-frame.

83. (New) The method of claim 79 wherein the second information is a fixed-length code.

84. (New) The method of claim 83 wherein the fixed-length code is a 2-bit code that represents 4 possible states of the one or more spatial resolution scaling factors.

85. (New) The method of claim 79 wherein the second information is a variable-length code.

86. (New) The method of claim 79 wherein the first information is signaled in a sequence header.

87. (New) The method of claim 86 wherein the first information is a 1-bit code in the sequence header.

88. (New) The method of claim 79 further comprising:
outputting third information in the bitstream, the third information indicating a selected re-sampling filter.

89. (New) The method of claim 79 wherein the one or more spatial resolution scaling factors comprise a vertical spatial resolution scaling factor and a horizontal spatial resolution scaling factor.

90. (New) The method of claim 89 wherein the vertical spatial resolution scaling factor differs from the horizontal spatial resolution scaling factor.

91. (New) The method of claim 89 wherein the vertical spatial resolution scaling factor is selected from a set of vertical spatial resolutions comprising full resolution and half resolution.

92. (New) The method of claim 89 wherein the horizontal spatial resolution scaling factor is selected from a set of horizontal spatial resolutions comprising full resolution and half resolution.

93. (New) The method of claim 79 wherein the one or more spatial resolution scaling factors are determined adaptively based at least in part on bitrate criteria.

94. (New) The method of claim 79 wherein the one or more spatial resolution scaling factors are determined adaptively based at least in part on high-frequency content criteria.

95. (New) The method of claim 79 wherein the one or more spatial resolution scaling factors are determined adaptively based at least in part on quantization step size criteria.

96. (New) The method of claim 79 further comprising:
if multiple spatial resolution coding is enabled for the sequence, encoding the sequence of video frames with multiple spatial resolution coding according to the spatial resolution scaling factors indicated by the second information;
otherwise, encoding the sequence of video frames without multiple spatial resolution coding.

97. (New) The method of claim 96 further comprising:
down-sampling a current frame of the plural frames, wherein the down-sampling yields a reduced-resolution frame.

98. (New) The method of claim 97 wherein the down-sampling comprises applying a 6-tap filter to the current frame.

99. (New) The method of claim 97 wherein the down-sampling comprises down-sampling in a horizontal direction prior to down-sampling in a vertical direction.

100. (New) The method of claim 79 wherein a current frame of the plural frames includes plural lines, and wherein the multiple spatial resolution coding for the current frame includes adjusting number of samples in each of the plural lines so the number is a macroblock multiple.

101. (New) A system comprising:

means for receiving and processing first information in a bitstream for a sequence of video frames, wherein the first information indicates whether multiple spatial resolution coding is enabled for the sequence;

means for receiving and processing second information at frame level in the bitstream for each of plural frames in the sequence if the first information indicates that multiple spatial resolution coding is enabled for the sequence, the second information indicating one or more spatial resolution scaling factors; and

means for outputting a result of the processing.

102. (New) One or more computer-readable media having stored thereon instructions operable to cause one or more computers to perform a method for decoding a bitstream for a sequence of video frames, the method comprising:

receiving and processing first information for the sequence, wherein the first information indicates whether multiple spatial resolution coding is enabled for the sequence;

if the first information indicates that multiple spatial resolution coding is enabled for the sequence:

receiving and processing second information at frame level in the bitstream, the second information indicating one or more spatial resolution scaling factors for the frame; and
outputting a result of the processing.

103. (New) A system comprising:

means for outputting first information in a bitstream for a sequence of video frames, the first information indicating whether multiple spatial resolution coding is enabled for the sequence; and

means for outputting for each of plural frames in the sequence second information at frame level in the bitstream if the first information indicates that multiple spatial resolution coding is enabled for the sequence, the second information indicating one or more spatial resolution scaling factors for the frame.

104. (New) One or more computer-readable media having stored thereon instructions operable to cause one or more computers to perform a method of encoding a bitstream for a sequence of video frames, the bitstream having plural levels, the method comprising:

outputting first information for the sequence, the first information indicating whether multiple spatial resolution coding is enabled for the sequence; and

if the first information indicates that multiple spatial resolution coding is enabled for the sequence, for each of plural frames in the sequence:

outputting second information at frame level in the bitstream, the second information indicating one or more spatial resolution scaling factors for the frame.